Exemption No. 4891

United States of America
Department of Transportation
Federal Aviation Administration
Washington, D.C. 20591

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| In the matter of the petition of<br><br>Parker Hannifin Corporation<br><br><br><br>for a partial exemption from § 29.305(a) and (b) of the Federal Aviation Regulations | Regulatory Docket No. 003SW |

GRANT OF EXEMPTION

By letter dated August 10, 1987, Mr. Gary Korosi, Senior Engineer, Parker Hannifin Corporation, Aircraft Wheel and Brake Division, 1160 Center Road, P.O. Box 158, Avon, Ohio 44011, petitioned on behalf of Parker Hannifin for an exemption from § 29.305(a) and (b) of the Federal Aviation Regulations (FAR) to allow supplemental type certification (STC) of a wheel landing gear for the Bell Helicopter Textron Model 412 transport category helicopter using the standards contained in § 29.501(a)(2) and (3) for skid landing gear elastic spring members. This petition applies only to the energy absorbing (by yielding), replaceable elastic spring members of the wheel landing gear for the petitioner's STC application.

Sections of the FAR affected:

Section 29.305(a), in part, states that the structure must be able to support limit loads without detrimental or permanent deformation.

Section 29.305(b), in part, states that the structure must be able to support ultimate loads without failure.

Section 29.301(a), in part, defines ultimate loads as limit loads multiplied by prescribed factors of safety. In § 29.303, the factor of safety prescribed is 1.5. For a wheel landing gear, ultimate load is limit load multiplied by 1.5.

Section 29.501 contains standards for rotorcraft skid landing gear and provides unique criteria for elastic spring members. Section 29.501(a)(3) states, in part, that design ultimate loads for elastic spring members need not exceed those obtained from a "reserve energy" drop test of the landing gear. Reserve energy test standards are contained in § 29.727. Section 29.501(a)(2) states that structural yielding of elastic spring members under limit load is acceptable.

The petitioner's supportive information is as follows:

A primary design concept of this light weight tricycle wheel landing gear provides for yielding of the support tubes for nose wheel and also the cross tube for the main wheels, under limit loads, to absorb the rotorcraft landing impact energy. This design feature or concept is identical to that of a skid landing gear allowed by § 29.501(a)(2), and (3).

Reason for request:

This gear, as designed, is considerably lighter than a conventional oleo type wheeled gear. Since this helicopter was designed and is equipped with a "yielding under limit load" skid type landing gear, fuselage modifications for the STC installation will be kept to a minimum. The installation of this wheeled gear on the Model 412 will reduce the power required for taxiing, thus reducing turbulence and associated airborne debris during taxi operation.

Ground taxi, rather than hover taxi, is considerably safer because less energy is required. The aircraft is more responsive to change in direction, and the aircraft may be stopped quickly by main wheel brake application. In addition, the main wheel brakes may be applied independently for directional control. Ground taxi is also quieter than hover taxi.

A considerable fuel savings will be recognized by operators of this aircraft by being able to ground taxi instead of having to hover taxi. Also, the added convenience of the aircraft being able to taxi closer to the terminal will reduce ground traffic necessary to transport passengers from helicopter landing zones to the terminal.

Safety:

The current qualification criteria for helicopter skid landing gear allowing yielding under limit loads have been used by the helicopter industry for approximately 25 years with a favorable safety record. The elastic spring members of existing skid gears operate at high stress levels, but these high stress levels occur infrequently. High loads occur at "limit or reserve energy" contact sink speeds of 6.55 feet/second and 8 feet/second, respectively. These contact velocities or "sink speeds" very rarely occur in helicopters during normal, typical operation due to the inherent characteristic of "rotating wings." This capability is manifested in hovering before touchdown. Therefore, whenever high stress levels are attained in service and visible yielding of the elastic spring members occurs, the cross tubes and spring members are replaced due to permanent set or yielding long before fatigue life (or potential failure) becomes a problem.

Exception to this occurs when configuration of the landing gear is later altered by the addition of significant mass items (i.e., floats, training shoes, skis, etc.) that alter the resonant frequency of the landing gear assembly. When a resonant frequency may be excited, low load dampers, with loads low enough not to interfere with energy absorption, have been utilized to eliminate or reduce the vibration amplitude and the attendant high frequency stress levels to an acceptable safety factor (or level).

The petitioner states two objectives for this STC design are:

a. Damping devices will be used, if required, to avoid significant resonant vibration and to attain a safe and economically acceptable service life.

b. The final gear design configuration will result in wheeled landing gear load factors derived from § 29.725 limit drop tests that are less than, or equal to, the currently certified Bell Model 412 landing load factors.

Public interest:

The public is interested in conserving energy (fuel), avoiding supplemental means of transportation at airfields, and using aircraft in an efficient, economical manner. The public is also interested in reducing airport noise levels and improving safety of helicopter operations, especially in terminal areas.

Petitioner's summary:

Based on the foregoing, it would be in the public's best interest to grant an exemption from § 29.305(a) and (b) of FAR Part 29 for wheeled gear elastic spring members and permit use of the following standards for certification of the energy absorbing spring members:

a. Section 29.501(a)(2) which states that structural yielding of elastic spring members under limit loads is acceptable.

b. Section 29.501(a)(3) which states that design ultimate loads for elastic spring members need not exceed those obtained in a drop test of the gear with a reserve energy drop in accordance with § 29.727.

The final design configuration will be such that landing load factors will be less than, or equal to, the currently certified load factors for the Bell Model 412 helicopter configuration. Therefore, recertification of the Model 412 airframe would not be required.

A summary of the petition was published in the Federal Register on October 8, 1987 (52 FR 37699). No comments were received.

The Federal Aviation Administration's (FAA) analysis/summary is as follows:

The petitioner has applied for certification of a unique wheel landing gear design that may be described as a modular or somewhat self-contained landing gear. This concept will require very few changes to the Model 412 airframe structure and systems before installation of this wheel landing gear. The operational uses of the helicopter can be expanded with the advent of low power taxiing capability.

The requirements of § 29.501(a)(2) and (3) and similar standards in Part 27 for normal category rotorcraft skid landing gear have proven satisfactory for rotorcraft skid landing gear since 1950. The petitioner's wheel landing gear design is very similar to typical skid landing gear designs except wheels are attached at the extremities rather than skid tubes. The landing impact energy is absorbed identically in the design by yielding or deformation without collapse of the mechanical elastic spring members. The petitioner has proposed a means to identify and control the effects of any resonant vibrations by damping devices on the wheel landing gear design to achieve a safe and economically acceptable (to the operators) service life. The petitioner has chosen as a design objective airframe landing load factors that are equal to or less than the present Bell Model 412 design landing load factors. This should allow installation of this modular landing gear on the Bell Model 412 with very few changes in the airframe structure, facilitating "field" conversions and significantly reducing conversion costs. Taxiing the Model 412 helicopter over typical surfaces may impose frequent and significant stresses on the landing gear. This was not specifically addressed by the petitioner's letter but will be considered as proposed previously by the petitioner in conjunction with flight resonant conditions under § 29.571. In addition, as a typical part of the STC program, compliance with the ground resonance prevention means, § 29.663, will be required as previously proposed by the petitioner. Any necessary inspections or replacement criteria for the landing gear or other component determined in the process of this certification program should be contained in an STC maintenance manual supplement to the basic Model 412 manual.

In consideration of the foregoing, I find that a grant of exemption is in the public interest and would not adversely affect safety. Therefore, pursuant to the authority of §§ 313(a) and 601(c) of the Federal Aviation Act of 1958, as amended, delegated to me by the Administrator (14 CFR 11.53), Parker Hannifin Corporation is granted a partial exemption from § 29.305(a) and (b) to the extent necessary to certificate the elastic spring members of a wheel landing gear design, provided:

1. Compliance with § 29.501(a)(2) and (3) is established for the elastic spring members;

2. The Bell Model 412 is substantiated for the landing load factors derived for the appropriate conditions of § 29.477 for the wheel landing gear design; and

3. Compliance with § 29.571 is established for the landing gear for an appropriate operating envelope.

This exemption shall remain in effect indefinitely, unless sooner superseded or rescinded by the Federal Aviation Administration.

Issued in Fort Worth, Texas, on December 30, 1987.

Don P. Watson

Don P. Watson
Acting Director, Southwest Region